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General Specifications for Grading and Building Earth Roads.

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BY

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General Specifications for Grading and Building Earth Roads.

The alignment, width, grades, crown, drains, ditches, cross-drains and all dimensions, shall be those determined upon by the engineer, superintendent, supervisor, commissioner, or others having charge of the work. They shall be ample to meet the requirements of the prospective traffic, and will be clearly stated in the blanks prepared for and which must be used by the bidders.

Contractors will be required to conform strictly to the dimensions, grades and forms as thus specified, and any departure therefrom must be sanctioned by written authority to entitle the contractor to extra compensation, and, unless otherwise expressly stated, such additional authorized work shall be paid for at the same rate as that bid for similar material in the original contract.

CLASSIFICATION OF MATERIALS.

The material and work will be classified into clearing and grubbing, earth, hard pan, loose rock, solid rock, iron pipe, terra-cotta and stone drains, "trunks," catch-water drains and berm ditches, sodding, paving, fencing and masonry. Bridges and culverts may be let separately or may be included in the same contract with the grading at the discretion of the proper authority.

By *earth* will be meant ordinary clay, sand, gravel, top soil, humus or other alluvial material commingled with loose or imbedded stones which do not exceed one cubic foot in size or about 175 lbs. in weight.

Hard Pan is defined to include tough, indurated clay or cemented gravel so compact, as, in the opinion of the engineer or road supervisor, to require blasting for its removal.

Loose Rock will include all loose boulders between one cubic foot and one cubic yard in size or all mineral deposits, in mass, which may be quarried by sledge and crowbars, such as the inter-stratified sedimentary rocks; as clay, shales or slates, sandstones, limestones, decomposed schists, soapstone, &c., where the strata are not more than eight inches in thickness, and where blasting is unnecessary, even though it may be resorted to by the contractor, at his option.

Solid Rock shall include all other indurated mineral deposits *in situ*, which require blasting for removal.

Ditches will include all open surface conduits, whether parallel to the road or leading away therefrom. When paved they will be known as *gutters*.

Drains are covered conduits, underlying the road bed or the soil in its vicinity. They may be composed of broken stone, when they are termed *blind drains*; of rough rubble, laid dry, but leaving an open channel, known as *French drains*; of pipes of different material, such as *iron, cement, or terra-cotta, clay or unglazed pipe*; of wooden boxes, called "*trunks*;" of rough masonry, scabbled and laid to line, either dry or in mortar, "*box culvert*;" or of cut-stone masonry with arched top or invert, "*arch culvert*." *

CLEARING AND GRUBBING.

In opening a new road through timber lands or underbrush, the undergrowth and small trees less than six inches in diameter shall be cut close to the surface for the full width of the right-of-way, and the parts not suitable for cord-wood, for fencing, for fascines or for mats in swampy bottoms shall be piled for burning.

Trees of large diameter shall be cut up into the most profitable commercial forms for the available market, the limbs and tops being split up for fencing and the brush reserved for facinage or piled for burning.

All roots and stumps within the width of the wagon-way or foot-path, if there be one, shall be removed to a depth of eighteen inches below finished grade, by grubbing, blasting or other means.

GRADING.

The mould, top-soil or humus containing vegetable matter must be excavated from the bed of the road and may be deposited in spoil banks at points designated by the engineer or other officer, where it will not wash into the road, ditches or drains; or it may be spread over adjacent farms, with the consent of the owners, where it will not injure the property or crops.

The sub-soil, if of good quality for roads, should be disturbed as little as possible but should be "crowned" and graded to conform to the neat lines

* *Note*.—The size of the water way for culverts and drains may be computed from the following formula as given by Rudolph Hering, C.E.

$$Q = cr \sqrt[4]{\frac{S}{A}}$$

Where Q = the number of cubic feet, per acre per second reaching the mouth of a drain or pipe.

c = a coefficient ranging from .31 to .75, depending on the nature of the surface. Average recommended is .62.

r = average intensity of rain fall in cubic feet per acre per second.

S = the general grade of the area, per thousand.

A = the area drained in acres.

of the profile and sections determined upon; not with the plough when near sub-grade, but with the scraper, pick, or shovel. All stones exceeding two inches in diameter should be removed from the surface, which should be thoroughly rolled after the material has been spread and crowned, by a roller weighing not less than one half of a ton per lineal foot.

In heavy clay soils, where practicable, sand and gravel may be added to the surface in the proportion of sixty-two parts of gravel to twenty-two of sand. After being thoroughly and uniformly mixed it should be spread of equal thickness over the previously prepared bed and be rolled until it will sustain a static load of one ton per square foot without depression.

This surface should be "crowned" with slopes of not less than two inches to the yard, rising uniformly from the ditch toward the centre, but no mud, muck or wash from ditches shall be used for this purpose. The grades for an earth road should be limited, where practicable, to five feet per hundred (5 per cent.)

The width of the traveled way should not be less than one rod (giving two acres to the mile) and for the right of way four rods (between fences).

DRAINAGE.

In general, ditches shall be opened on both sides of the wagon way, of such dimensions and grades as shall be prescribed by the engineer or other authority. When specified, drains may be substituted, or they may be omitted entirely where, at the discretion of the engineer, they may be unnecessary or detrimental. Catch-water and berm ditches shall be built as required by the topography or soil. Cross-drains, mitre-drains, pipes or trunks shall be built on or under the bed of the road wherever specified or required, and be made to accord with the exigencies developed during construction. The outlet drains shall be opened at as frequent intervals as possible into natural channels, and shall have a uniformly descending grade not exceeding one foot per hundred (1 per cent.) where practicable. The line of such outlets shall be so selected as to produce the least injury to property, and be placed at such points as may be required. They shall be made to discharge freely into the natural water courses. Care should be taken, as much as possible, to conduct the drainage away from the road bed rather than toward it, and to this end the grades, where practicable and expedient, shall be kept above the general level of the adjacent lands. In thorough cuts the surface water shall be intercepted by berm ditches where it flows toward the road, and the side slopes should be sown in grass after the top soil has been spread over them, when the expense is not too great.

BOX CULVERTS

shall be of good rubble masonry, well scabbled, or of squared stones well laid. The ends for a length of four feet from the face shall be laid in good mortar, the remainder of the side walls may be laid dry. The tops shall be made level and solid. The bottom, when paved, shall be laid with suitable

stone set on end or edge, well bedded and made to break joint. Stop plank or sheet piling shall be driven under the bed, when and where required, to prevent wash-outs.

The cap-stones for spans, varying from six to four feet, shall have a thickness of not less than ten (10) inches, and a lap at each end of one foot. For a four-foot culvert, or less, the cap-stones may be not less than six inches thick and have a lap of at least eight inches.

All the material and workmanship shall be subject to approval by the engineer or other proper authority.

Foundation trenches shall be dug to the required depth by the contractor, who shall construct the necessary flumes, dams and sluices for keeping them dry during the laying of the masonry. He shall also provide such temporary works as may be necessary to afford a passage for the traffic without interruption or danger, and to afford fencing to preserve crops or other property from injury or trespass, and all tools, plant, false-works, or scaffolding necessary for the proper execution of his contract.

RETAINING AND SLOPE WALLS.

Retaining walls for heavy clay or loamy soils dipping toward the road bed and liable to slide, shall be of substantial masonry laid in cement mortar. They may be of a trapezoidal section, having a uniform batter on the face of six to twelve feet vertical to one horizontal. The top thickness shall not be less than two feet; the bottom not less than one-third the height of the wall. The back may be stepped off in courses from three to five feet in height with level, but random, berms.

Weepers, or drain tiles, shall be inserted at or near the bottom of the wall at intervals not to exceed ten (10) feet and of sufficient size to afford ample drainage, and they shall be connected in rear of the wall by coarse back filling of rip-rap, gravel, or other loose material. Where such is not available, brush without leaves may be used, laid in bundles or fascines. The back-filling which rests immediately against the wall, shall be of such coarse texture as readily to permit water to pass down to the outlet drain pipes to prevent lodgment and freezing. This precaution should be rigidly observed.

The weepers must be placed so high as to prevent their becoming clogged at their outer ends by deposits in the ditches along the toe of the walls.

GENERAL CONDITIONS APPLICABLE TO ALL WORK.

All materials used in the construction of the road will be subject to the classification, inspection and acceptance of the engineer, who will submit them to such tests as he may desire.

Commodious passing places, for public and private roads, shall be made and kept in good condition by the contractor, and he shall provide and maintain good and sufficient fences, for keeping up enclosures and the pre-

servation of crops. The contractor will be held responsible for trespass or damage to the adjacent properties or the public, for any acts or omissions on the part of himself or his employés.

Any parties under the direction of the engineer shall be permitted to pass or haul any material required for the road over any section, such persons not interfering with the work of the contractor. Right of way and necessary lands for borrow pits, spoil banks, channels, ditches, roads, etc., will be provided by the supervisor or county commissioners, as early as practicable, but they are not to be held responsible for any delay caused by legal proceedings beyond their control.

Contractors must carefully preserve bench marks and stakes; in case of neglect they will be charged accordingly. Falls and slips, if not occasioned by the negligence of the contractor, are to be paid for the same as the regular classification.

The contractors shall take all risks from floods and casualties of every description, and shall make no charge for detention from such causes, but shall be entitled to a reasonable extension of the time for the completion of the work.

The quantities marked on the profile are an approximation, and will not govern the final estimate.

Disorderly and quarrelsome persons must be discharged by the contractor, if in the opinion of the engineer the good of the road requires it.

Contractors will not themselves, nor by their agents, give nor sell any ardent spirit to their workmen, or any person at or near the line of the roadway; or allow any to be brought on the works by the laborers or any other persons, and will do all in their power to discountenance their use in the vicinity of the work by persons in their employ; and they will not allow any person in their employ to commit trespass on the premises of persons in the vicinity of the works, and will forthwith, at the request of the trustees or engineer, discharge from their employ any that may be guilty of committing damage in this respect.

Contractors must satisfy themselves of the nature of the soil; of the general forms of the surface of the ground; of the quantity of materials required for forming the embankments or other work, and all matters which can in any way influence their contract; and no information upon any such matters derived from the maps, plans, profiles, drawings or specifications, or from the engineer or his assistants, will in any way relieve the contractor from all risks or from fulfilling all the terms of this contract.

The contractors will remove, at their own expense, any materials disapproved by the engineer, and will remove and re-execute any works, without extra charge, and within such time as fixed by the engineer, appearing during the progress or within twelve months after completion, to be unsoundly or improperly executed, notwithstanding any certificate as to the due execution of the same.

The contractor will give personal attention to the work.

The engineer shall have power to direct the application of force to any portion of the work which in his judgment requires it. And to order the increase or diminution of force at any point he may indicate.

MONTHLY ESTIMATES.

Measurements and estimates shall be made by the engineer, once in each month, by means of which may be known approximately the amount of work done, and the contractor shall be entitled to payment therefor, at such rates below his contract price as may be agreed upon by the parties to the contract; it being understood that the contractor has no claim on account of any material not laid in its place in the roadway, or for labor bestowed thereon; and the quantities shall be estimated from the dimensions when so laid, though, on the advice of the engineer, advances may be made on such material when delivered for use, in which case it becomes the property of the company, in the contractor's care and keeping, and he becomes liable for its loss or injury.

Upon completion of the work all refuse, rubbish, or useless material shall be removed, and the site be left in neat and proper order.